Designation: C938 – 16

Standard Practice for Proportioning Grout Mixtures for Preplaced-Aggregate Concrete[1]

This standard is issued under the fixed designation C938; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This practice describes the laboratory procedure for selecting proportions for grout mixtures required in the production of preplaced-aggregate (PA) concrete.

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

C125 Terminology Relating to Concrete and Concrete Aggregates

C150/C150M Specification for Portland Cement

C185 Test Method for Air Content of Hydraulic Cement Mortar

C219 Terminology Relating to Hydraulic Cement

C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

C637 Specification for Aggregates for Radiation-Shielding Concrete

C937 Specification for Grout Fluidifier for Preplaced-Aggregate Concrete

C939/C939M Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

C940 Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

C941 Test Method for Water Retentivity of Grout Mixtures for Preplaced-Aggregate Concrete in the Laboratory

C942 Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory

C943 Practice for Making Test Cylinders and Prisms for Determining Strength and Density of Preplaced-Aggregate Concrete in the Laboratory

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminologies C125 and C219.

4. Summary of Practice

4.1 Grouts at fluid consistency are prepared from one or more mixtures of cement, pozzolan, fine aggregate, grout fluidifier, with or without other chemical admixtures, and water, and tested to determine:

4.1.1 The properties of the grout, and

4.1.2 The properties of PA concrete made with the grout when the grout is intended for such use.

4.2 The procedure and equipment required for mixing this grout are prescribed in this practice.

5. Significance and Use

5.1 This practice provides a standard procedure for selecting proportions for mixtures of grout to be used at fluid consistency in the production of PA concrete meeting applicable criteria for strength, density, and other properties.

5.2 This practice is also useful for determining the composition of grout mixed at fluid consistency and meeting specified requirements for filling voids, cavities, and spaces in rock, foundations, and concrete structures.

6. Apparatus

6.1 *Mixer,* constructed as shown in Fig. 1. The three mixer blades shall be made of steel plate, 3-mm thick, with a 100- by 125-mm elliptical shape. Each blade shall have two 25- by 75-mm slots centered on the major axis, and shall be welded to the shaft at an angle of approximately 23° with the horizontal in such a way as to force grout to the bottom of the mixer

[1] This practice is under the jurisdiction of ASTM Committee C09 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.41 on Hydraulic Cement Grouts.

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[2] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

***A Summary of Changes section appears at the end of this standard**

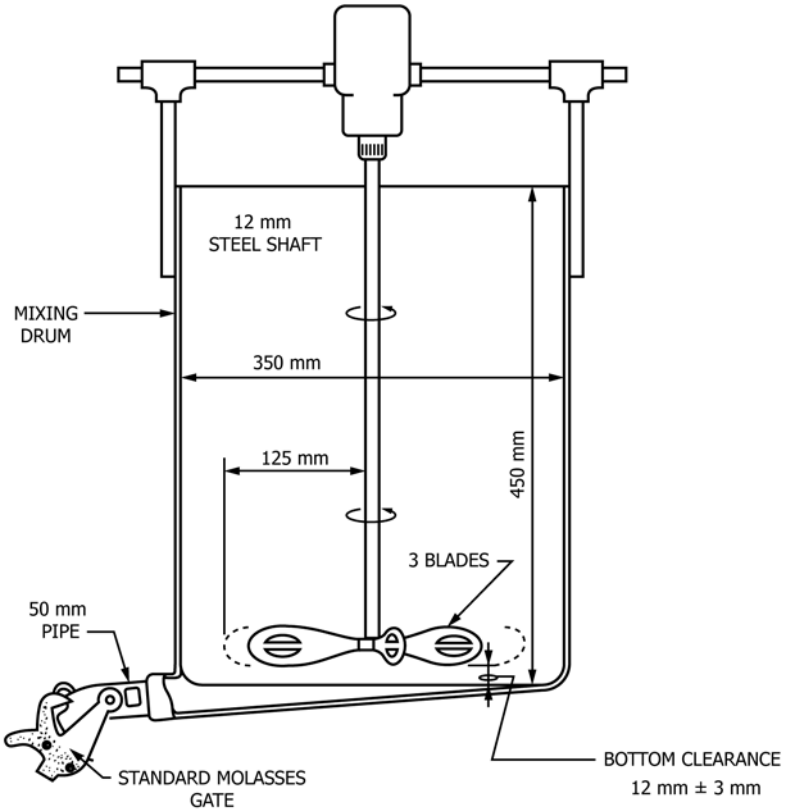

FIG. 1 Grout Mixer

during rotation. The mixer blades shall be powered to rotate at approximately 275 r/min under load.

6.2 *Scales or Balance,* accurate to within 0.3 % of the test mass at any point within range of use.

6.3 *Jaw Caliper,* capable of measuring up to 300 mm with a resolution of at least 0.1 mm.

7. Materials

7.1 Materials for test purposes, except mixing water, shall meet the following requirements unless otherwise specified in project documents:

7.1.1 Portland cement, Specification C150/C150M, nonair-entraining,

7.1.2 Pozzolan, if used, Specification C618,

7.1.3 Fluidifier, Specification C937, and

7.1.4 Fine aggregate, Specification C637, Table number 2, Grading 1 for relative density under 3.0 and Grading 2 for specific activity 3.0 or heavier.

7.2 Where grout is being proportioned for use on a specific project, materials for test purposes shall be from and representative of the same source or type and description as will be used or is being considered for use on the project.

7.3 *Mixing water,* if clean and potable, is acceptable for normal test purposes.

8. Sampling

8.1 Samples of mixed grout for testing shall be representative of the batch from which they are drawn.

8.2 Agitation of the batch shall be continuous until all samples required from that batch have been drawn.

8.3 Grout in the mixer shall not be retempered by the addition of water. If mixing water is added in increments to adjust fluidity, a new batch shall be prepared for testing.

8.4 Samples shall be drawn for testing in the following order: (*1*) consistency, (*2*) expansion and bleeding, and (*3*), other requirements.

9. Conditioning

9.1 Maintain laboratory at and bring all grout materials to 23.0 ± 2.0°C unless otherwise specified.

10. Procedure

10.1 Prebatch grout ingredients by mass to provide a batch volume after mixing of approximately 0.03 m^3.

10.2 The first trial mixture, unless otherwise specified, shall contain equal parts, by mass, of cementitious material and fine aggregate, fluidifier in amount 1 % mass of cementitious material, unless otherwise recommended by manufacturer, and sufficient water to produce a flow of 21 ± 2 s. The cementitious material shall consist of two parts of portland cement to one part of pozzolan by mass.

10.3 In subsequent trial mixtures, the proportions of materials shall be varied as needed to satisfy design criteria. Adjusted mixtures may contain a cementitious ratio of portland cement to pozzolan other than as stipulated for the first trial mixture.

10.4 Dampen the inside of the mixer drum, turn the mixer on and charge the ingredients within 2 min in the following order: (*1*) water, (*2*) fluidifier, (*3*) pozzolan (if used), (*4*) portland cement, and (*5*) fine aggregate. After all materials have been added, mix for 3 to 3¼ min.

10.5 Determine the following fluid grout properties in the order shown of each trial mixture:

Property	Test Method
Flow (time of efflux)	C939/C939M
Expansion and bleeding	C940
Water retentivity	C941, if required
Density	see 10.5.1
Other	as required

10.5.1 Determine the density of the fluid grout using the measure described in the Apparatus section under "Measure" in Test Method C185. Pour the grout into a container, tap the side lightly five times with a tapping stick as described in Test Method C185, strike off, then measure mass.

10.6 Determine the following hardened grout and PA concrete properties:

Property	Test Method
Compressive strength of grout	C942
Compressive strength of PA concrete	C943, if required
Density of grout	see 10.6.1
Density of PA concrete	see 10.6.1, if required

10.6.1 To determine the density, D, of grout or PA concrete, measure mass, m, of the specimen to an accuracy of at least 0.3%.

10.6.1.1 *Cubes*—Take two measurements of each dimension to the nearest 0.1 mm. Compute the volume, v, from average measurements.

10.6.1.2 *PA Cylinders*—Take measurements of two diameters at right angles at approximate mid-height. Measure the length of the cylinder at opposite ends of a diameter. Make all measurements to the nearest 0.1 mm. Compute the volume from average measurements as follows:

$$D = m/v \quad (1)$$

11. Report

11.1 For each mixture, including the final mixture, the following shall be reported:

11.1.1 A description of all materials used including type and alkali content of portland cement, type of pozzolan, source and name of fluidifier, and sieve analysis and relative density of fine and coarse aggregate.

11.2 For each trial mixture the following fluid grout properties shall be reported: (*1*) time of efflux, (*2*) expansion and free water, (*3*) water retentivity (if required), (*4*) and other specified data.

11.3 For final mixture(s) selected, the report shall include compressive strength of grout at ages of 7, 28, and 90 days, and density unless otherwise required.

11.4 For PA concrete cylinders, the report shall include compressive strengths at ages of 7, 28, and 90 days, and density unless otherwise required.

12. Keywords

12.1 concrete; grouts; pre-placed aggregate

SUMMARY OF CHANGES

Committee C09 has identified the location of selected changes to this practice since the last issue, C938–10, that may impact the use of this practice. (Approved Feb. 1, 2016.)

(1) Revised to SI only standard by removing inch pound informational units.

(2) Included description of jaw caliper.

(3) Clarified descriptions of density terms throughout.